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UTILITY PATENT APPLICATION

FOR

PEELABLE COATING COMPOSITION

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TITLE: **PEELABLE COATING COMPOSITION**

This is a Continuation-In-Part of copending United States Application Serial No. 09/815,874 filed on March 23, 2001 and Serial No. 09/693,366 filed on October 20, 2000; and Provisional application Serial No. 60/191,506 filed on March 23, 2000; and Provisional Application Serial No. 60/500,290 filed on September 4, 2003 all of which are incorporated by reference herein.

Technical Field

This invention relates generally to a water resistant peelable protective foam coating compositions, and, more specifically, to water based, polymeric foam coating compositions which form a protective and/or decorative coating with the ability to adhere to a variety of smooth or porous solid substrates, including automotive paints, metals, glass, plastics, vinyl, cloth, paper, asphalt, concrete, porcelain, and ceramics, etc., and to be removed, and more specifically, peeled off, easily from smooth substrates.

Description of the Prior Art

A demand exists for a coating composition suitable for the temporary protection of the surface of an article through the depositing on the surface of a coating which can be subsequently be easily removed, and more specifically, peeled off, from the surface without altering the surface or requiring a surface pretreatment.

For example, in the case of painted or polished metal manufactured articles such as automobiles, a need exists for such a coating composition to protect the automobile against weathering, contamination from the atmosphere, chemical attack or accidental damage during handling. Moreover, often the paint on the front end of a motor vehicle or around the outer edges of the fenders is chipped or otherwise damaged by rocks or

other small hard objects flying from the road. If dead bugs and bird droppings are left to remain on the paint for a prolonged period of time, permanent stain marks may appear even after cleaning of the automotive body surface. The vehicle's body surface may also be scratched by pets, during delivery from the dealership, or even during transportation and storage from shipping.

A need also exists for a temporary, peelable coating for the purpose of decoration, either seasonal or occasional, which is easily applied and removed to items such as windows, doors, hood and trunk lids, tailgates, or buildings and other objects such as metal, plastic, glass, wood, brick, or block, etc. A three-dimensional coating is more desirable to the consumers/users since it offers better visibility and greater design possibilities. The peelable foam coating of the current invention can be applied to a painted surface, or coated surface such as chrome or chrome plated plastic, to prevent damage to the paint.

SUMMARY OF THE INVENTION

This invention relates generally to water resistant peelable protective and decorative clear, translucent, reflective, phosphorescent, or pigmented coating composition and, more specifically, to water based, polymeric coating compositions which form a protective and/or decorative coating on a variety of substrates, including automotive paints, metals, plastics, glass, cloth, paper, asphalt, concrete, porcelain, and ceramics.

The peelable foam coatings are aqueous based and include pressurized liquid or gas carrier and may form a generally flat raised ribbon of film on the substrate, or expand providing a raised three-dimensional coating whereby the dimensions of the foamy coating can be controlled by the formulation and applicator to form an expandable cord, string, lines, or figures, and/or for filling in a template in the shape of a desired

design, be it a letter, symbol, or other art form.. The coating may be formulated for temporary or long-term protection and/or for decorative art purposes. The peelable foam coating is fast drying due to the evaporation of the liquid carrier and does not depend upon cross-linking of the resin polymer(s) or application of radiation to cure. The adhesive properties of the foam resist migration, yet form a peelable film on the substrate and form a skin over a gas filled cellular matrix providing a means to control the depth or thickness of a single application of the peelable foam coating or multiple layers. The adhesion of the multiple layers can be controlled based on the time of curing to produce layers peelable from one another, or layers adhering to one another with a selected amount of migration between selected layers providing a means to control the color, thickness, and/or texture or the layers.

The coating may be formulated for temporary or long term protection, and may be either thin or thick . The thickness and density of a single layer or multiple layers can be designed with a porosity to maximize the energy absorbing characteristics of the peelable foam coating as well. The invention also relates generally to water based peelable foam coating composition and their method of application by brush, roll, squeeze tube, crayon, marker, ink pen, foam, jell, paste, spraying, dipping, and as an aerosol. The coating can be applied in a single or multiple layers which adhere to one another without bleeding together. The layers may be separated from one another upon drying enabling the user to position cords or strands of the coating composition for decorative purposes or portraying a written or graphic message. The peelable foam coatings may be applied according to their rate of curing (evaporation of the liquid carrier) in order to minimize or maximize the adhesive properties of the peelable coating layers and their capability to adhere and bond to one another.

In one preferred method, the peelable foam coating may be applied using an aerosol filled applicator with a tube or spout of a selected length and width to control the expansion of the foam creating a strand or cord of uniform width and depth. The

resulting strand or cord will generally form a smooth sealed exterior skin enclosing a porous interior providing structural integrity thereto.

It is an object of the present invention to provide a decorative, scratch resistant means for protecting the paint, glass, plastic, or metal portions of automotive vehicles during storage and shipping, and against road hazards, debris, bugs, etc. depending upon the particular embodiment selected imparting a tough resistant, impact absorbing characteristic or more elastic film characteristic. The peelable coating may also be formulated to be an excellent insulating material against scratch or damage to individual parts and may used as packaging material to spray or paint particular parts, such as automotive parts or military equipment prior to shipping.

The present invention provides a protective peelable coating which can be applied to a painted or coated surface of a motor vehicle such as an automobile, airplane, boat, snowmobile, motorcycle, or other vehicle forming a removable coating which can be peeled away leaving a fresh paint surface in a condition at least as good as before application of the removable coating.

Moreover, removal of the film often removes dirt and contaminants covering the painted surface. The present invention may also be utilized as a removable protective coating for transporting and storing tools and equipment and applied to the bottom surface of snow and water skis, surf boards, snow boards, and other sporting accessories which require a smooth slick surface for optimum performance.

A clear and colorless, tinted, or pigmented coating may be applied to the goods to be protected in the form of an expandable foam of a particular width and depth depending upon the application. Moreover, logos, writing and other graphic designs may be formed by and/or imprinted on the coatings using paint, ink, dye, or the like, and removed from the substrate by peeling the coating from the substrate surface. For

example, an advertisement displayed on an automobile windshield or even the painted portions of the auto. It is also contemplated that multiple layer of coatings may be applied providing means to decorate an object. It is contemplated that an effective amount of micro beads or small glass spheres or other particles composed of other materials may be added to the formulation to aid in the release of the coating and may be used alone or in combination with the chemical release agents set forth hereafter.

Although not required, the peelable foam coating may be applied to a substrate such as a painted surface after pretreating the substrate with a pretreatment composition such as a fatty acid soap, water and/or alcohol solution, silicon, polish, paste, or wax in order to minimize or eliminate any residue left on the substrate from removal of the peelable film together with contaminants adsorbed by the peelable foam coating from the substrate leaving a clean surface outline due to dirt or grim left on the surface surrounding the peelable foam coating.

A preferred embodiment of the peelable coating composition comprises a film former, a release agent, and a surfactant. A liquid propellant in an aerosol can is employed to create a foamy peelable coating. A foam promoter may be added to the composition. A humitant such as propylene glycol may also be optionally added to the composition to provide a means to control the foam structure through evaporation. A glycol such as propylene glycol might also be considered to be a release agent and function as a plasticizer as well. Dyes such as CHROMATINT X-1619, and/or pigments, thickening agents, anti-skinning agents, stabilizers, and bactericides may be incorporated into the peelable coatings formula to enhance particular physical and decorative characteristics of the product.

Accordingly, it is an object of the present invention to provide a clear, translucent, pigmented, flourescent, dyed, tinted, or illuminative coating for application

to a metal, plastic, glass, cloth, ceramic, clay, fiber, concrete, brick, rock, cinder block, paper, film, or wood surface.

It is an object of the present invention to provide a peelable coating in which metal flakes, powders, or other decorative particles can be embedded throughout.

It is an object of the present invention to be applicable in a pressurized container, tube, or syringe.

It is an object of the present invention to provide a peelable coating which can be removably placed upon a solid substrate such as paints, metals, plastics, concrete, natural and synthetic elastomers, and ceramics and used as a means of removably supporting another substrate such as a metal foil, a plastic film, STYROFOAM, foam product, paper, or one or more additional layers of peelable coating forming a sandwich therewith.

It is an object of the present invention to provide a aqueous based carrier for the peelable foam coating for use on metal, plastic, glass, paper, or wood surfaces having existing protective coatings of paint, varnish, film, without damaging the existing protective coatings.

It is another object of the present invention to produce a peelable coating which does not damage the surface.

It is yet another object of the present invention to produce a protective coating which will not damage paint, chrome, plastic, fiberglass, or other substrate to be coated therewith.

It is another object of the present invention to produce a coating which is easily to apply as a liquid, foam, jell, paste, semi-solid, or aerosol.

It is another object of the invention to provide a coating embodiment having an interior cellular matrix formed by gas bubbles entrapped within polymeric membranes providing a three-dimensional aspect to the peelable coating so that the coating can be seen from an angle yet minimize the amount of pigment and other effective components in the formulation. And the three-dimensional aspect adds to the design possibilities for the consumers/users.

It is another object of the peelable foam coating embodiment to be applied to surfaces without complicated apparatus.

It is yet another object of the peelable foam coating embodiment to include a propellant so that the coating can be sprayed from a can as an aerosol.

It is yet another object of the foamy coating embodiment to be applied through an extension tube to control the size and shape of the coating, and offer more structural design to the three-dimensional foams.

It is another object of the present invention to form an expandable polymeric peelable foam coating having structural integrity formed by cells which exhibits memory and a tendency to retain its shape and appearance upon curing.

It is yet another object of the foamy coating embodiment to be applied at ambient temperature and dry on a surface (becomes non-tacky) within about 5 to 10 minutes of application and become peelable from the surface within an hour of the application.

It is another object of the present invention to provide a peelable foam coating composition which is not soluble in water upon drying.

The foregoing objects are accomplished by providing an expandable foam coating including a film forming effective amount of: a film forming polymeric resin such as an aqueous polyurethane dispersion; a selected release agent such as soy lecithin, (a release and foaming agent), for a polyurethane resin or a polyglycol may be used for a polyvinyl alcohol resin; a propellant such as a hydrocarbon propellant; a surfactant profoamer such as akanolamide. Optionally, an effective amount of a plasticizer such as an aliphatic polyurethane; an antiskinning agent such as polyglycol; a thickening agent such as a sodium polyacrylic polymer; an aqueous carrier and/or solvent carrier such as alcohol or preferably alcohol/water blend. Other components such as pigments, dyes, stabilizers, waxes, and dispersing agents although not required may be added to provide desired special characteristics and properties to the peelable foam coating formed thereby.

More particularly, a preferred embodiment comprises a peelable foam coating composition comprising a selected aqueous resin dispersion, such as an aqueous polyurethane dispersion, in an effective amount ranging of up to 95 percent by weight and generally from between 60 to 95 percent by weight, and more preferably from about 70 to 90 percent by weight; and a release agent in an effective amount of up to 10 percent by weight and generally ranging from between about 0.5 to 7.5 percent by weight, s surfactant profoamer in an effective amount of up to 10 percent by weight and generally from between 0.5 to 5.0 percent by weight, and a hydrocarbon propellant in an effective amount of up to 30 percent by weight and generally from between 5 to 20 percent by weight, can be used to provide a peelable foamy film. Effective amounts of other components such as pigments for color and stability such as titanium dioxide and organic pigments, thickening agents such as acrylic polymers, fragrances, and an antiskinning agent such as polyglycol, each one in effective amounts up to 10 percent by weight and preferably from about 0.01 to 5.0 percent by weight, may also be utilized in with the selected resin dispersions and more particularly with one preferred embodiment utilizing an aqueous polyurethane dispersion.

The resulting peelable coating exhibits excellent toughness, gloss, elasticity, resiliency, flexibility, abrasion resistance, and adhesion. It is resistant to impact and absorbs impacts, weathering, acids, and alkalies. It is a coating which is impervious to water, and is resistant to most of the chemical solvents. It may be applied by brush, roll, spray, extrusion, or dipping, and preferably by spraying from an aerosol can, onto surfaces.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the present invention will be had upon reference to the following description in conjunction with the accompanying drawings in which like numerals refer to like parts throughout the several views and wherein:

Figure 1 is a partial perspective view of a peelable foam coating container, dispenser, and nozzle;

Figure 2 is a top view of Figure 1;

Figure 3 is a front view of Figure 1;

Figure 4 is a side view of the entire container, dispenser, and nozzle for the expandable and peelable foam container of Figure 1;

Figure 5 is a perspective view showing the container, dispenser, and nozzle, of the invention of Figure 1 including a funnel for spreading and controlling the dimensions of the foam expanding therefrom;

Figure 6 is a perspective view showing a portion of generally cylindrical piece of strand extruded from the expanded peelable foam coating and showing the smooth outer surface forming a skin and the porous interior structure thereof;

Figure 7 is a perspective view showing a portion of generally flattened piece of peelable foam strand having an ovular cross-section extruded from the expanded foam and showing the smooth outer skin surface and porous interior structure thereof;

Figure 8 is a sectional view of a dry mound of foam showing the cellular interior formed by the expansion and trapping of the gas bubbles and showing the formation of a smooth membrane or skin on the exterior surface, and formation of a film on the substrate surface; and

Figure 9 is a perspective view showing application of the peelable foam coating in a decorative manner applied to an automobile shown in phantom lines.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the peelable foam coating composition comprising a film former, a surfactant profoamer, a release agent, and a propellant. Dyes and/or pigments, thickening agents, anti-skinning agents, stabilizers, bactericides, and plasticizers may be incorporated into the peelable coatings formula to enhance particular physical and decorative characteristics of the product.

The expanded foam may be applied by attachment of a straw or tube 10 attached to the nozzle 12 of a pressurized container 14 such as is shown in Figures 1- 4. A round or ovular funnel 16 as best illustrated in Figure 5 may be used to aid in controlling the expansion of the foam as it exits the straw and before application to the surface of the substrate. It is anticipated that dies or templates can be attached to the distal end of the

straw to provide strings of foam having selected cross-sectional shapes such as are shown in Figure 6 showing a string 18 having a cylindrical shape and Figure 7 showing a string 20 having an ovular shape. Moreover, an extension onto the straw may provide a depth gauge by holding the nozzle tip at a selected distance above the substrate surface to provide for application of the peelable foam coating at a selected uniform depth for applications such as the decorative coatings shown in Figure 9, wherein the peelable foam coating is applied to a vehicle providing decorative logos 22.

The peelable coatings and peelable foam coatings of the present invention are unique in that upon curing, defined as evaporation of the solvent (i.e. water), the coating can be peeled and removed from the substrate in substantially a single piece because the tensile strength or cohesion of the resin particles comprising the peelable coating is greater than the adhesion of the film to the substrate being coated thereby. Most protective coatings and/or foam insulation composed of polymers such as polyurethane typically exhibit great adhesion to the substrate surface than other particles of the composition characterized by having a tacky or sticky surface.

One preferred composition for the peelable foam coating composition comprises a film forming polymeric resin dispersions such as an aqueous polyurethane dispersion having about 50% solids at between 60 to 95 percent by weight, and more preferably 70 to 90 percent by weight. A selected release agent such as soy lecithin or polyglycol of from 0.1 to 10 percent by weight and more preferably from 1 to 5 percent by weight is used for a polyurethane resin dispersions, polyvinyl alcohol resin dispersions or other aqueous based resin dispersions. A surfactant profoamer such as a silicone surfactant of from 0.1 to 10 percent by weight and more preferably from 0.5 to 5.0 percent by weight, is used to promote the foam. A propellant such as a hydrocarbon or chloroflorinated hydrocarbon propellant of up to 30 percent by weight and more preferably from 5 to 20 percent by weight provides the gas. A thickening agent such as a sodium polyacrylic polymer may be utilized in an amount of up to 5 percent by weight. A foam stabilizer

such as alkanolamide may be added in an amount of from between 0.01 and 10.0 percent by weight.

Optionally, a preferred embodiment includes a plasticizer such as an aliphatic polyurethane in amount of from between 0.01 to 10 percent by weight. An antiskinning agent such as an antioxidant may also be added in an amount of from between 0.01 and 2 percent by weight and more preferably between 0.1 and 1 percent by weight. An aqueous carrier and/or solvent carrier such as alcohol or preferably alcohol/water blend may be used in an amount of up to 30 percent by weight. Other components such as pigments, dyes, stabilizers, waxes, and dispersing agents in effective amounts up to 10 percent by weight, and preferably from 0.01 to 10 percent by weight may be added to provide desired special characteristics and properties to the peelable foam coating formed thereby.

The peelable foam coating produced therefrom provides a three-dimensional peelable coating with thickness ranging from 0.1 to 2 inch, more preferably 0.25 to 1 inch. The peelable coating embodiment having a glossy or semi-glossy surface preferably utilizes an effective amount of solids content of a polyurethane dispersion of at least 20 percent. Greater amounts of solids are required to obtain a peelable foam coating containing at least 30 percent and more and preferably of about 40 percent or more in order to prevent unwanted porosity and prevent collapse of the foam upon application. Moreover, the three-dimensional aspect of the preferred embodiment is preserved by using a polyurethane dispersion of about 40 percent solids or greater, producing a coating having structural integrity from the moment of application to days and weeks after the application of the coating to the substrate.

In the present invention, a selected surfactant is used to produce the foam. The resin content of the present invention is high enough to provide structural support for the foam during drying so that the formation of the foam formed by expulsion of the of the

selected gas from the container expands at a predictable rate and volume, and forms a peelable foam coating having a density in a selected range, with cellular cavities formed by bubbles in a desired size range. The evaporation of the water, or water/solvent blend carrier results in curing of the expanded peelable foam coating forming the film on the substrate, the skin on the exterior surface, and cell membranes having dimensions in a particular range providing structural support therefor. Although the top surface of the expandable peelable foam is solid upon curing, during the drying and curing process tiny pores are formed in the skin by evaporation of the aqueous based carrier. An alkanolamide may be utilized to retain foam stability and control shrinkage. The use of additives such as plasticizers, leveling agent, waxes, and/or pigments which have a tendency to migrate to the surface of the skin may reduce or eliminate visibility of the pores.

As shown in Figure 8, the present invention is shown as a sectional view of a mound of peelable foam coating showing the interior cellular matrix 24 containing a plurality of cells 26 formed by the expansion and temporary trapping of the gas bubbles and showing the formation of a smooth membrane or skin 28 forming the exterior surface, and formation of a film 30 on the substrate surface.

Moreover, the expandable foam of different colors or having other different properties may be contained within a single container or a plurality of containers leading to a manifold, or combining straws, or having a nozzle which combines the streams of expanded peelable foam in the same manner as is conventionally used to create toothpaste-like structure having stripes.

The film former is a polymeric resin dispersion, or a mixture of polymeric resin dispersions, which form a film after curing or drying. The resin in the preferred embodiments is a polyurethane dispersion, which can be obtained from Bayer, Ruco Polymers, NeoResins, Witco, Reichhold, etc. Other resin dispersions such as polyvinyl

alcohol, polyvinyl styrene butadiene copolymers, polyvinyl toluene butadiene copolymers, styrene acrylate, vinyl toluene acrylate copolymers, styrene acrylate copolymers, vinyl toluene acrylate terpolymers, amino-formaldehyde resins, polyvinyl butyral and polyisocyanate resins may be used in combination therewith.

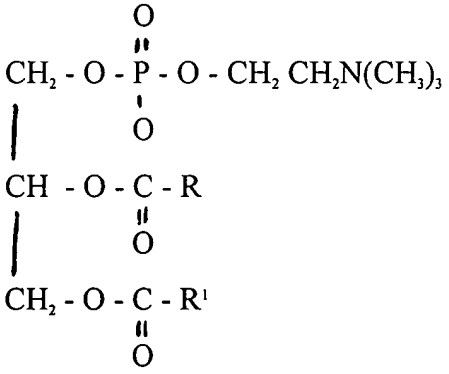
Polyurethane provides a tough but flexible film for use in the peelable coating. The resin selected is preferably UV resistant and may have a stabilizer incorporated therein. The resins may vary in molecular weight and viscosity depending upon the characteristics desired in the resulting peelable coating.

A particularly useful embodiment incorporates the polyurethane within a controlled foam which quickly dries imparting body to the film leaving a smooth outside surface. The term "foam", as used herein, designates a mixture of liquid, gas, and a surfactant that gives the liquid a film strength which permits the formation of long lasting bubbles when the mixture is agitated to convert it into a mass of bubbles, the membrane of which is composed of the polymer molecules providing the distinct shape and structural integrity of the whole system. The liquid used is normally water, which could be the water from the aqueous resin dispersions, and the gas is usually air, because these ingredients are of low cost, but other liquid and/or gas can be used when compatible with the surfactant, for example, a pressurized hydrocarbon as the gas component. The strength of the membrane film depends upon the characteristics of the polyurethane dispersion and the surfactant, and the relative amount of liquid and surfactant in the liquid-gas-surfactant mixture.

In the foamy coating embodiment no extra solvent is necessary for the formulation; water introduced from the resin dispersion itself acts as the solvent to the system. However, an optional amount of water or other solvent up to the amount of 10 percent by weight may be introduced into the embodiment to enhance the solubility/dispersability of other components.

One or more release agents and/or aids may be utilized individually or in combination in the peelable coating compositions of the present inventions. Preferred release agents include soy lecithin, organosilicone fluids, nonylphenoxypoly(ethyleneoxy)ethanol, oleic acid polyethylene glycol monostearate, petrolatum, sodium alkyl benzene, sulfonates, siloxanes, polyglycols, silicone surfactants, polyvinyl alcohol resins, paraffin and polymeric waxes, and synthetic waxes including low molecular weight polyethylene waxes. It is contemplated that the formulas in the examples set forth herein could utilize any of these release agents wherein the selected release agent depends upon its solubility, availability, and cost and environmental considerations. Polydimethylsiloxane type surfactants also function as a release agent to some extent. One preferred organo silicone fluid is available from Dow Corning and sold under the trade name of DOW CORING Q4-3667 as a polydimethyl-polyether-siloxane blockcopolymer.

A typical release agent used in the examples is soy lecithin, for example:



The lecithins are mixtures of diglycerides of fatty acids linked to the choline ester of phosphoric acid and may be classified as phosphoglycerides or phosphatides (phospholipids). Moreover, the lecithin may be a mixture of acetone-insoluble phosphatides of not less than 50% acetone-insoluble matter. The soy lecithin is derived from soybeans. In the present invention the soy lecithin has a dual function as both a release agent and a foaming agent.

In a preferred foamy coating embodiment, a surfactant is added in order to enhance the foamability and reduce the bubble size in the foams, in an effective amount of from between 0.1 to about 10 percent by weight, more preferably from about 0.5 to 5 percent by weight. The term "surfactant", as used herein, refers to surface-active agent which is consisting of an amphophilic molecule (a molecule with a hydrophilic head attached to a long hydrophobic tail). The hydrophilic group may be anionic, cationic, amphoteric or nonionic. As used in the present invention, the addition of a surfactant to a liquid system reduces the liquid's surface tension and promotes foaming. Typical foaming agents include polydimethylsiloxane, alkanolamides, silicone glycols, alkyl benzene sulfonates, alcohol ethoxylated, phosphate esters, betaines, alkylphenol ether sulfates, alkylaryl sulfonates. It is anticipated that other foaming agent such as proteins and fatty acids may be utilized in combination with the polydimethylsiloxane surfactants. Thus, the organo silicone type fluids can be used as both a surfactant and release agent alone or in combination with another release agent such as the soy lecithin.

In a preferred foamy coating embodiment, a pressurized liquid propellant is utilized as a carrier to apply the foamed film coating. The preferred embodiments of the present invention use a nonfloronated propellant. A commercial liquid hydrocarbon propellant which is compatible with the preferred composition may be selected from the pressured propane/isobutane/butane blends, with the most preferred propellant as 46 psi or 70 psi for use with particular compositions. Hydrocarbon propellant is selected from the group consisting of A-31, A-46, A-55, A-70, or A-108, and/or propane/isobutane/butane blends. The composition may contain up to 30 weight percent of the propellant, and more preferably from 5 to 20 weight percent of the propellant. Moreover as set forth in Examples 13-15, and 17, the peel foam composition can be formulated as a premix liquid concentrate and mixed with a desired amount of propellant. For example, a typical formula may contain about 88 percent by weight of a premix liquid concentrate and about 12 percent by weight of a selected propellant.

Thickeners applicable to all of the formula may be utilized to control the application properties of the coating composition, but are optional, such as sodium polyacrylate, Carbopol EZ-2 (acrylic polymers), Polyox WSR (high molecular weight, (mol. wt.), polymers of ethylene oxide) from Union Carbide, xanthan gums, guar gums, polyacrylic acid, polysaccharides. Fillers such as silica, cellulose, wood flour, and clays may also be utilized, although are optional, with the resins of the preferred compositions.

Moreover, a flow resistant component may be used and defined as a thickening agent to impart body in the film coating. Solvent soluble/water dispersible compounds which have good film foaming characteristics such as Drewthix (Drew Chemicals) may be utilized independently or in combination with other thickening agents to impart desirable characteristics to the film.

Another water-soluble thickening agent is carboxymethylcellulose (CMC). The CMC may be dissolved at about 1.5% in water and be added to the formulation in an effective amount of up to 25 percent by weight, preferably from about 0.01 to 10 percent by weight, and more preferably from about 0.1 to 5.0 percent by weight.

The preferred composition of a film-type coating may contain up to 10% thickeners and more preferably up to 8 weight percent thickeners, and more preferably up to 3 weight percent thickeners.

An anti-skinning agent may be added to the formulation and is particularly useful for propellant carried foamy coatings and is preferably used in combination with a foam stabilizer. Typical anti-skinning agents are antioxidants used to inhibit formation of an oxidized film on the exposed surface. The anti-skinning agent provides a means for rapid drying and curing of the foam from the "bottom-up" so that the resulting film dries more quickly and thoroughly and provides a smoother, more glossy appearance having some body. An effective amount of an anti-skinning agent, such as Exkin No. 2, of up to 1

percent by weight may be utilized in a preferred embodiment, and preferably up to 0.2 weight percent.

Inorganic and organic colorants, which include dyes or pigments, preferably pigments, such as the 896 Aqueous Industrial Colorants series from Degussa, Inc., and/or stabilizer/pigment combinations, such as titanium dioxide, may be utilized in an effective amount of up to about 10.0 percent by weight, more preferably up to 5 percent by weight, and most preferably from 0.5 to 2 percent by weight.

Microbiocides, pH control agents, UV stabilizers, etc., may be incorporated in the composition in an amount of from between about 0.01 to about 1.0 percent by weight of the total composition.

In coating embodiments which contain aqueous polyurethane dispersions, no extra plasticizer is necessary since the peelable foam coating formed by the polyurethane already possesses enough plasticity and flexibility. Although not required for use with a polyurethane dispersion resin, a plasticizer may be used to impart flexibility to other selected resin dispersions or even added to the polyurethane formulation to impart special physical characteristics to the selected resin such as to facilitate processing and to increase the flexibility and toughness of the final product by internal modification (solvation) of the polymer molecule. Numerous plasticizers are available for utilization in the present invention and may be selected from the group including phthalate, adipates, sebacate esters, and more particularly: glyceryl tri(acetoxystearate), epoxidized soybean oil, epoxidized linseed oil, N,n-butyl benzene sulfonamide, aliphatic polyurethane, epoxidized soy oil, polyester glutarate, polyester glutarate, triethylene glycol caprate/caprylate, long chain alkyl ether, dialkyl diester glutarate, monomeric, polymer, and epoxy plasticizers, polyester based on adipic acid, hydrogenated dimer acid, distilled dimer acid, polymerized fatty acid trimer, ethyl ester of hydrolyzed collagen, isostearic acid and sorbian oleate and cocoyl hydrolyzed keratin, PPG-12/PEG-65 lanolin oil,

dialkyl adipate, alkylaryl phosphate, alkyl diaryl phosphate, modified triaryl phosphate, triaryl phosphate, butyl benzyl phthalate, octyl benzyl phthalate, alkyl benzyl phthalate, dibutoxy ethoxy ethyl adipate, 2-ethylhexyldiphenyl phosphate, dibutoxy ethoxy ethyl formyl, diisopropyl adipate, diisopropyl sebacate, isodecyl oleate, neopentyl glycol dicaprate, neopenty glycol diotanoate, isohexyl neopentanoate, ethoxylated lanolins, polyoxyethylene cholesterol, propoxylated (2 moles) lanolin alcohols, propoxylated lanoline alcohols, acetylated polyoxyethylene derivatives of lanoline, and dimethylpolysiloxane. Other plasticizers which may be substituted for and/or used with the above plasticizers including glycerine, polyethylene glycol, dibutyl phthalate, and 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate, and diisononyl phthalate all of which are soluble in a solvent carrier.

Plasticizers especially useful are differentiated primarily by the molecular weights. The plasticizers are generally classified as formulated aliphatic polyurethane compounds. Either one or a combination of plasticizers of different molecular weights may be used in the formula depending upon the desired viscosity of the coating. Of course, it is contemplated that aromatic polyurethane compounds will also be applicable in the formula for the coating. The amount of plasticizer may range from about 0.1 percent to about 10 percent by weight.

EXPERIMENTAL EVALUATION

The following examples are presented to illustrate the claimed invention and are not intended to be otherwise limiting.

A preferred embodiment of a water resistant, peelable, protective and decorative clear or pigmented water-based coating composition producing a three-dimensional foamy film of about ¼ in thick for use on a variety of substrates, including automotive paints, is set forth in Example 1, as follows:

EXAMPLE 1

INGREDIENT	PERCENT BY WEIGHT
Aqueous polyurethane dispersion	60-95
Release agent	0.1-10
Surfactant profoamer	0.1-10
Hydrocarbon propellant	5-20
Colorant (red, blue, white, etc.)	0-5

The aqueous polyurethane dispersion was mixed with the rest of the constituents except the propellant in a container, and then the mixture was transferred into an aerosol can where the pressurized liquid propellant was forced into the said aerosol can to mix with the said mixture. A regular spray nozzle with a push-down button, or with a push-down cap, may be used to apply the coating, and more preferably, an extension tube may be added onto the snout of the push-down button or cap to control the size and shape of the coating, and offer more structural design to the coating. The extension tube may be tapered at the opening and extending outwardly at a constant dimension as shown in Figure 1, or spread in a cone or generally flat "V" shaped nozzle to control the spread or width, and depth of the expansion of the foam depending upon the application. Within seconds after application, the expandable foam will assume shape and form a skin on the exterior holding in the micro bubbles and forming a porous interior matrix as shown in Figure 8, providing structural strength to the resulting cord, strand, or other graphic art or the selected dimensions.

The preferred water based compositions include an effective amount of an aqueous polyurethane resin dispersion. The aqueous polyurethane dispersion is a waterborne, colloidal dispersion of aliphatic urethane. The average molecular weight is between about 50,000 and 5,000,000, more preferably between about 100,000 and 1,000,000. The

foamy coating embodiment preferably utilizes a resin content of polyurethane dispersion above 40 percent solids, in order to prevent unwanted porosity and prevent collapse of the foam upon application. Moreover, the three-dimensional aspect of the preferred embodiment is preserved by using a polyurethane dispersion of about 40 percent solids or greater, producing a coating having structural integrity from the moment of application to weeks after the application of the coating to the substrate. The aqueous polyurethane ranges in amount from about 60 to 95 percent by weight, and more preferably from about 70 to 90 percent by weight. About 83 percent by weight of the aqueous polyurethane dispersion was used in Example 1.

Water in the aqueous polyurethane dispersion itself provides enough solvency/dispersing medium for the rest of the components, therefore, no extra solvent is necessary in the formulation. However, an optional amount of water or other polar solvent up to 10 percent by weight may be added into the formulation to cut down cost, to enhance the evaporation of the solvent in the system, and/or to enhance the solubility of other components in the mixture.

The preferred embodiments of the present invention use a nonfloronated hydrocarbon propellant, although pressurized air, N_2, CO_2 may also be used. A commercial liquid hydrocarbon propellant which is compatible with the preferred composition may be selected from the group of A-31, A-46, A-70, or A-108 propane/isobutane/butane blends, with A-46 and A-70 being the most preferred propellant for use with particular compositions. The composition may contain up to 30 weight percent of propellant, and more preferably from 5 to 20 weight percent of propellant. About 12 percent by weight of the propellant A-46 was used in Example 1.

A release agent such as a soy lecithin in an amount ranging from about 0.1 to about 10 percent by weight, more preferably from about 1 to 5 percent by weight, is utilized in the aqueous polyurethane dispersion. Other water soluble or dispersible release agents

described heretofore may be utilized with or substituted for the soy lecithin. About 2.2 percent release agent was use in the embodiment of Example 1.

A surfactant profoamer may be added into the formulation to enhance the foaming ability during applying the coating. Surfactants are used for this purpose, which can be either anionic, cationic, amphoteric or nonionic. Typical foaming agents include polydimethyl siloxane alkanolamides, silicone glycols, alkyl benzene sulfonates, alcohol ethoxylated, phosphate esters, betaines, alkylphenol ether sulfates, alkylaryl sulfonates. Polydimethyl siloxane may function as a release agent as well, so it is preferably used in the embodiment of the foamy coating formulation. In the present Example 1.8 percent by weight of the polydimethyl siloxane surfactant is used as the preferred profoamer.

Additional preferred compositions of the above formulation may be formulated to provide foamy peelable coatings with particular characteristics by blending the compounds as follows.

The above-composition may be formed as a clear to off-white (depending on the coating thickness) foamy peelable coating composition or tinted with a colorant in an effective amount of up to 10 percent by weight. At least one preferred embodiment utilizes a pigment (red, blue, white, green, etc.), either organic or inorganic, in an effective amount of between 0.01 to 5 percent by weight, more preferably from between about 0.2 to 3 percent by weight, and most preferably from between about 0.5 to about 2 percent by weight. The composition of Example 1 utilized 1.0 percent by weight of colorant, or a water-dispersible titanium dioxide pigment for color and stability.

EVALUATION OF PEELABLE FILM IN EXAMPLE 1

The foamy films were applied onto an automotive paint panel using a push-down cap with a extension tube connected to the snout and let dry in ambient temperature (64 to 78°F) and humidity (20%-70% R.H.). The thickness of the foamy coating can range from 0.1 to 2 inch, more preferable 0.25 to 1 inch. The resulting dry films were foamy, three-dimensional, with a semi-glossy outside surface, and with the bulk structure sponge-like. The panel was then immersed in tap water and examined at selected intervals to determine if any of the component leached out. No color change of water was found during the test, and water did not show any impact on the film's integrity. The surface tension of the water was reduced a little, indicating that some of the surfactant was leaching out. Since the foam structure had already be formed and become rigid through air dry, the leaching out of the surfactant didn't affect the dry foam structure at all. The foamy coatings were also heated to 150°F for 72 hours and then taken out from the oven and dipped in cool tap water at about 64°F. No adverse effects were demonstrated on the film coating which remained on the painted substrate.

The peelabilty of the above-mentioned films were excellent, which could be peeled away from the substrate as a whole piece. The film was foamy and very elastic. Long-term peelability was demonstrated by letting the coated paint panel in the open-air environment for a certain amount of time, and then peeled off from the substrate, and the surface of the substrate was evaluated both visually and with a microscope. Coatings of 200 days in open-air environment were peelable from the substrate as a whole piece. No apparent fading of the color was noticed for the coatings in open-air environment for 200 days, and no surface damage on the substrate was noticed.

The following examples 2-10 illustrate some additional water based polymeric dispersions which can be used in the preparation of water resistant, peelable, protective and decorative clear or pigmented three-dimensional foamy film compositions of the present invention. Unless otherwise indicated in the following examples and elsewhere

in the specification and claims, all parts and percentages are by weight, temperatures are in degree Fahrenheit, and pressures are at or near atmospheric pressure.

The following general procedure is utilized for preparing the water based polymeric coatings of Examples 2-17. The aqueous polymeric dispersions was mixed with the colorants, release agents, surfactants, thickening agent in a container, and if a foamy peelable coating was desired the mixture was transferred into an aerosol can where the pressurized liquid propellant was forced into the said aerosol can to mix with the mixture.

Example 2

Component	Pts. wt.
Polyurethane	84.75
Soy Lecithin	3.00
Organo silicone fluid (Dow Corning)	1.15
Aqueous Industrial Colorant (Degussa, Inc.)	1.00
Acrylic copolymer thickener (Drew Chemical)	0.10
Hydrocarbon Propellant (Aeropres)	10.00

Example 3

Component	Pts/wt.
Silicone polyurethane copolymer (BF Goodrich)	83.40
Soy Lecithin	4.00
Organo Silicone fluid (Dow Corning)	1.50
Aqueous Industrial Colorant (Degussa, Inc.)	1.00
Acrylic copolymer (Drew Chemical)	0.10
Hydrocarbon Propellant (Aeropres Corp)	10.00

Example 4

Component	Pts/wt.

Polyurethane (Reichhold)	84.94
Soy Lecithin	2.98
Organo silicone fluid (Dow Corning)	1.06
896 Aqueous Industrial Colorant (Degussa, Inc.)	0.99
Acrylic copolymer (Drew Chemical)	0.10
Hydrocarbon Propellant (Aeropres Corp)	9.93

Example 5

Component	Pts/wt.
Vinyl Acetate-Vinyl Chloride-Ethylene Terpolymer (Air Products)	84.61
Soy Lecithin	3.25
Organo silicon fluid (Dow Corning)	1.20
Aqueous Industrial Colorant (Degussa, Inc.)	0.84
Acrylic copolymer (Drew Chemical)	0.10
Hydrocarbon Propellant (Aeropres Corp)	10.00

Example 6

Component	Pts/wt.
Silicone Acrylic Copolymer (Avery)	85.60
Soy Lecithin	2.80
Organo silicon fluid (Dow Corning)	1.06
Aqueous Industrial Colorant (Degussa, Inc.)	1.00
Acrylic copolymer (Drew Chemical)	0.10
Hydrocarbon Propellant (Aeropres Corp)	9.44

Example 7

Component	Pts/wt.
Styrene Butadiene Copolymer (BF Goodrich)	84.61
Soy Lecithin	3.25
Organo Silicon Fluid (Dow Corning)	1.20
Aqueous Industrial Colorant (Degussa, Inc.)	0.84
Acrylic copolymer (Drew Chemical)	0.10
Hydrocarbon Propellant (Aeropres Corp)	10.00

Example 8

Component	Pts/wt.
Acrylic Nitrile Copolymer (BF Goodrich)	85.40
Soy Lecithin	2.50
Organo Silicon fluid (Dow Corning)	1.05
Aqueous Industrial Colorant (Degussa, Inc.)	0.95
Acrylic copolymer (Drew Chemical)	0.10
Hydrocarbon Propellant (Aeropres Corp)	10.00

Example 9

Component	Pts/wt.
Polyvinyl Butytral (Solution)	85.30
Soy Lecithin	2.50
Organo Silicon fluid (Dow Corning)	1.10
Aqueous Industrial Colorant (Degussa, Inc.)	1.00
Acrylic copolymer (Drew Chemical)	0.10
Hydrocarbon Propellant (Aeropres Corp)	10.00

Example 10

Component	Pts/wt.
Polyurethane (Richhold)	56.28
Silicone-acrylic copolymer (Avery)	28.47
Soy Lecithin	3.00
Organo Silicon fluid (Dow Corning)	1.15
Aqueous Industrial Colorant (Degussa, Inc.)	1.00
Acrylic Copolymer (Drew Chemical)	0.10
Hydrocarbon Propellant (Aeropres Corp)	10.00

Example 11

Component	Pts. wt.
Polyurethane	93.8
Soy Lecithin	2.6
Organo silicone fluid (DOW CORNING Q4-3667)	2.0
Aqueous Industrial Colorant (CHROMATINT X-1619)	1.0
Propylene Glycol	0.6

Example 12

Component	Pts. wt.
Polyurethane	94.8
Soy Lecithin	2.6
Organo silicone fluid (DOW CORNING Q4-3667)	2.0
Propylene Glycol	0.6

Example 13

Component	Pts. wt.
Polyurethane	93.8
Soy Lecithin	2.6
Organo silicone fluid (DOW CORNING Q4-3667)	2.0
Aqueous Industrial Colorant (CHROMATINT X-1619)	1.0
Propylene Glycol	0.6

Liquid Concentrate	88%	and
Hydrocarbon Propellant (A-55)	12%	

Example 14

Component	Pts. wt.
Polyurethane	94.8
Soy Lecithin	2.6
Organo silicone fluid (DOW CORNING Q4-3667)	2.0
Propylene Glycol	0.6

Liquid Concentrate	88%	and
Hydrocarbon Propellant (A-55)	12%	

Example 15

Component	Pts. wt.
Polyurethane	93.8
Soy Lecithin	2.6
Organo silicone fluid (DOW CORNING Q4-3667)	2.0
Aqueous Industrial Colorant (CHROMATINT X-1619)	1.0
Propylene Glycol	0.6
Liquid Concentrate	88% and
Hydrocarbon Propellant (A-55)	12%

Example 16

Component	Pts. wt.
Polyurethane	95.0
Soy Lecithin	3.0
Organo silicone fluid (DOW CORNING Q4-3667)	2.0

Example 17

Component	Pts. wt.
Polyurethane	95.0
Soy Lecithin	3.0
Organo silicone fluid (DOW CORNING Q4-3667)	2.0
Liquid Concentrate	88% and
Hydrocarbon Propellant (A-55)	12%

The following general procedure was utilized for characterizing the polymeric foam properties of the above examples 2-10. Foamy coating formulations as set forth in Examples 2-10 was contained in a pressurized aerosol can with pushdown button and spray nozzle. The foam was then applied into a standard polystyrene Petri Dishes (95X15 mm, **Fisher***brand*). The excess of coating material was removed by wiping with ruler from the dish surface then let the coating dry in humility-controlled room at ambient temperature. The drying time of coating is determined by the coating weight reaching constant and the foamy coatings removability. The foam volume was measured by adding the water to the dry foam coating until the water level reaching coating surface and using water weight as the volume of the coating.

Table 1

PEELABLE FOAM COATING PROPERTIES

Example	Polymeric Type	Coating Drying Time	Foam Density (g/cm³)
2	Polyurethane (PU)	2-2 ½ hrs.	0.214
3	Silicone Polyurethane Copolymer (Si-PU)	24 hrs.	0.236
4	Polyurethane (PU)	3-3 ½ hrs.	0.159
5	Vinyl Acetate-Vinyl Chloride-Ethylene Terpolymer	45-50 min.	0.629
6	Silicone Acrylic Copolymer (Si-Acrylic)	80-90 min.	0.486
7	Styrene Butadiene Rubber (SBR)	3-3 ½ hrs.	0.330
8	Acrylic Nitrile Rubber	90-95 min.	0.740
9	Polyvinyl Butytral	2-2 ½ hrs.	0.212
10	Mixture of Si-Acrylic/Polyurethane	1 ½ - 2 hrs.	0.085

These peelable foam coatings as set forth in Examples 2-10 were formulated with aqueous based resins which exhibit different physical properties and characteristics. It should be noted that the aqueous industrial colorant included in the formulations at a 1.00 weight percent could be omitted from any of the examples and replaced by a corresponding amount of resin or resin/solution. Moreover, the hydrocarbon propellent is not critical to the formation of the peelable films unless a foamy film is desired having a porous interior providing structural integrity to a thick peelable coating.

The remaining peelable coating compositions as set forth in examples 11-17, demonstrate compositions useful for decorative peelable coatings with and without a hydrocarbon propellant for formation of foamy coatings whereby the coating exhibits a high cohesive strength to resist tearing providing enhanced peelable characteristics as opposed to adhesive bonding to the substrate being coated therewith.

The foregoing detailed description is given primarily for clearness of understanding and no unnecessary limitations are to be understood therefrom, for modification will become obvious to those skilled in the art upon reading this disclosure and may be made upon departing from the spirit of the invention and scope of the appended claims. Accordingly, this invention is not intended to be limited by the specific exemplifications presented herein above. Rather, what is intended to be covered is within the spirit and scope of the appended claims.

Specific compositions, methods, or embodiments discussed are intended to be only illustrative of the invention disclosed by this specification. Variation on these compositions, methods, or embodiments are readily apparent to a person of skill in the art based upon the teachings of this specification and are therefore intended to be included as part of the inventions disclosed herein.

Reference to documents made in the specification is intended to result in such patents or literature cited are expressly incorporated herein by reference, including any patents or other literature references cited within such documents as if fully set forth in this specification.